Review of Evaluation Tools Used to Assess the Impact of Nutrition Education on Dietary Intake and Quality, Weight Management Practices, and Physical Activity of Low-Income Audiences

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ABSTRACT Nutrition education programs and social marketing campaigns frequently focus on low-income audiences with the goal of improving dietary intake and quality, weight management practices, and physical activity. The impact of nutrition education can be assessed by measuring change in relation to any or all of these broad variables. Unfortunately, little information is available concerning the reliability, validity, and sensitivity to change of measures used to assess these constructs with low-income audiences of adults and adolescents. This article reviews the literature and discusses the types of available measures that have been used and evaluated for the above audiences. It describes specific measures used to assess total diet, consumption of food groups from the Food Guide Pyramid, and behaviors related to weight management and physical activity. Overall, this review suggests that there is a critical need for additional development and evaluation of dietary quality measurement tools for low-income and minority audiences.

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INTRODUCTION

The impact of nutrition education programs on adults and adolescents has been under-researched. There is no gold standard for dietary evaluation of free-living people and little consensus concerning appropriate methods for assessing the impact of nutrition education on low-income populations. As a result, many have found it difficult to demonstrate the impact of nutrition education on the clients they serve. This article reviews dietary assessment methods that have been used with adult and adolescent low-income audiences. Measures of total diet and diet quality based on the Food Guide Pyramid (FGP) are reviewed regarding their reliability, validity, and practicality; however, testing with low-income audiences has not been done in most cases.[1] In keeping with the emphasis placed on weight management and physical activity in the 2000 Dietary Guidelines for Americans, methods for assessing these constructs are also reviewed.[2] Gaps in the literature are identified, and suggestions are offered for future research, practice, and policy making. For the purposes of this review, the FGP is used as the standard of dietary intake and quality since most nutrition education focuses on improving food consumption behavior.

MEASURES OF DIETARY QUALITY

Methods of measuring self-reported food consumption can be classified as (1) data collection at the time of consumption or (2) data collected about foods eaten in the immediate, recent, or distant past. Each method has strengths and weaknesses, and none can be considered as criterion mea-

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sures.[3–5] All measures that rely on self-reported food consumption have limitations influenced by the interviewer's skills and the respondent's judgment, memory, cooperation, ability to estimate serving sizes, and communication skills. Staff training and support may improve the quality of data obtained. For example, interviewers need to know that providing food models,[6,7] prompting, or other assistance may improve the accuracy of responses, especially for older adults and those with limited literacy skills.

CHARACTERISTICS OF INSTRUMENTS FOR MEASURING CHANGE IN DIETARY QUALITY

Table 1 summarizes the key characteristics of measures that have been used with low-income populations or with national or state-level surveillance studies, including most that are discussed in this article. The table provides a useful starting point in seeking more detailed information about a particular measure. The measures in this table are organized under categories that reflect the broad types of data collection instruments employed. These include 1-day and multiday FFQs, 24-hour dietary recall measures, food behavior checklists, measures of behavioral mediators of food group intake, and measures related to weight management and physical activity (PA). The table provides guidance for instrument selection, based on the following:

- *Topics.* The topics covered by data collection instruments.
- *Mode of Data Collection.* The recommended way to administer the instrument. Instruments may be administered in person or by telephone survey, in small groups of 2 to 15 individuals, or in large groups of 16 or more. Although the major constraint on the mode of administration is time (e.g., telephone interviews often result in discontinuation after 20 minutes), some instruments—such as 24-hour dietary recalls—are sufficiently complex to work better in person and in small-group settings. Instruments need to be reviewed for ease of administration, clarity of language, reading level, and cultural relevance and sensitivity.
- *Length.* This heading includes the length of an instrument estimated in terms of the number of items (including any follow-up items) or the number of minutes needed to complete a series of items. Administration time varies according to the education, cultural background, and eating habits of respondents.
- *Measurement Properties and Study Population.* Because measures can often perform differently in different populations, the entries in these columns begin with a brief description of the study population.
  - *Reliability.* Reliability may be reported as either internal consistency (i.e., Cronbach's coefficient alpha) or as test–retest reliability (typically expressed as a correlation coefficient).
  - *Validity.* Two types of validity information are included: (1) correlation of results from the instrument with results from a more detailed measure (e.g., 24-hour recall) and (2) consistency between results from the instrument and results from biochemical measures of nutritional status.
  - *Sensitivity to Change.* This column indicates the magnitude of the difference over time (expressed as a percentage of the baseline level) that was detectable as statistically significant. The population in which the change was observed is noteworthy because a measure's sensitivity to change will vary among different populations. The information in this column can help estimate the sample size needed for a study. Data from prior studies about the percentage of an audience engaged in behavior before and after the intervention can be used to estimate sample size requirements for future studies.
- *Comparative Data.* This column describes comparative data (if available) that may be used to address the generalizability of evaluation findings.

The section that follows discusses these measures as well as short-term dietary recalls and food frequency questionnaires (FFQs) because of their practicality for use in program evaluation with free-living, low-income adults and adolescents. Recommendations are made to reduce reporting bias. Additional information on dietary assessment methods is available from other sources such as the National Cancer Institute (NCI).[8].

Total diet measures. This section describes two types of measures of total diet that have ready application to evaluations with low-income audiences: (1) dietary recalls and (2) FFQs.

Dietary recall. The 24-hour dietary recall method is useful in determining the impact of dietary interventions on short-term food consumption of large groups (as opposed to individuals). It has many advantages. Owing to its lack of assumptions, it can be used for assessing mean intakes among diverse, heterogeneous, low-income groups. It is open ended; thus, its administration should alter eating behavior minimally.[3] It provides the educator with a "snapshot" of what an individual or group eats. Reviewing results with participants can possibly enhance education by generating interest, discussion, and self-examination. A 24-hour recall requires only 10 to 20 minutes to administer to individuals by trained interviewers and is therefore less expensive and less fatiguing than more detailed measures such as food records.[9] Doing dietary recalls in groups requires additional time and is more challenging. Despite the challenges, this is the primary means of assessing dietary quality and behavior change in established national programming for low-income audiences such as the Expanded Food and Nutrition Education Program (EFNEP).[10]

One primary disadvantage of the single 24-hour recall is that it is only scientifically valid when used with large samples. Because of the typical day-to-day variability in the foods

Table 1. Characteristics of instruments for measuring change in dietary quality.

				Measurement Properties and Study Population				
Indicator	*Topics*	*Mode of Data Collection*	*Length (Items or Min)*	*Reliability (Cronbach's alpha; Test–Retest)*	*Validity*	*Sensitivity to Change*	*Comparative Data*	*References*
Food frequency questionnaires								
BRFSS (CDC)	Fruits and vegetables (separately), juice Dairy and fats No specific foods listed	Telephone survey Small group Large group	6 items 4 items 13 items	Pop: 49 whites, 43 African Americans, 53 Hispanics in low-income central city neighborhood[12] Test–retest after 10–21 d, kappa[12]: Fruit Veg Total: .48 .20 Whites: .79 .07 African Americans: .31 .04 Hispanics: .46 .54	Pop: 73 low-income Hispanics Consumption of fruits plus vegetables to longer Block FFQ (r = .46)[13]	Not done; cross-sectional surveys	Annual state data for adults in homes with telephones; adults with less education[13,14]	Shea et al., 1991[12]; Serdula et al., 1993[13]; Serdula et al., 1995[14]
5 A Day (NCI)	Fruits and vegetables (separately), juice Only potatoes (fried and other) listed as specific foods	In person Telephone survey Small group Large group	7 items	Pop: 3737 rural African Americans 62% ≤ $20,000/year α = .80–.92[15]	Related to longer Block FFQ	Change over 1 year ($p \leq .05$)[19]	Data for selected communities	Campbell et al., 1996[15]; Campbell et al., 1998[16]; Havas et al., 1997[17]; McClelland et al., 1998[18]; Campbell et al., 1999[19]
California Dietary Practices Survey	Fruits and vegetables (separately), beans, milk products, whole grains, meats, fats, fried foods, sweets	Telephone survey	20 min	Pop: California telephone survey of adults Not reported	Not reported	Not done; cross-sectional survey	Data every 2 years by age, sex, race/ethnicity	Foerster et al., 1999[20]

Table 1. *Continued.*

				Measurement Properties and Study Population				
Indicator	*Topics*	*Mode of Data Collection*	*Length (Items or Min)*	*Reliability (Cronbach's alpha; Test–Retest)*	*Validity*	*Sensitivity to Change*	*Comparative Data*	*References*
FFQ used in Women's Health Trial feasibility study in minority populations	Fruits, vegetables (considered as individual foods), grains, fat	Self-administered In person or by mail	100 items	Pop: 1015 women (28% African American, 16% Hispanic) 15% < $15,000[22] Test–retest correlations (at screening) for fat (% energy): .37–.51 Correlations for other nutrients: .46–.62[22]	Correlation with 4-day food records: .15–.34[22]	Change over 6 mo ($p \leq .05$)	Not reported	Bowen et al., 1996[21]; Kristal et al., 1997[22]
Block Health Habits and History Questionnaire/ NCI	Fat, vitamins A and C; specific foods grouped into food groups, such as fruits, vegetables	Self-administered	98 items (original); 60-item version developed later	Pop: 50% African American, 50% women (n = 85) in Michigan[23] Not reported Pop: Low-income African-American female outpatients (n = 91) in Atlanta[24] Not reported	Correlation with 4-day diet: .42–.68[23] Correlation with serum carotenoids: .45[24]	Not reported in low-income population	Epidemiologic data	Block et al., 1986[23]; Coates et al., 1991[24]; Slattery et al., 1994[25]; Block et al., 1992[26]
Quick Check for Fat	Total fat, saturated fat, cholesterol	Self-administered Small groups	2–3 min (for subjects); ~28 foods	Pop: 75 clerical workers Test–retest correlations: .77–.81[27]	Related to NCI Health Habits and History ($p \leq .05$)	Not reported	Not reported	Schaefer et al., 1992[27]
24-hour dietary recall								
Many instruments	Food groups, nutrients	In person Small group	20–30 min	Pop: 58 low-income women with children[29] Not reported	Correlation with serum carotene: .34[29]	Change over ($p \leq .05$) 3–12 months[29]	Nationwide Food Consumption Survey; CSFII for low-income populations	Thompson and Byers, 1994[28]; Murphy et al., 1999[29]
Food behavior checklists								
California Food Behavior Checklist	Servings of fruits, vegetables Food behavior (e.g., use of spreads)	In person Telephone Small group Large group	14 items	Pop: low-income women with children (n = 110)[29] Not reported	Correlations with 24-hour recall: .28–.41	Change over 6 sessions ($p \leq .05$)[29]	None	Murphy et al., 1999[29]
Modified Food Habits Questionnaire	How food is prepared, consumption of fresh fruit, fried chicken	Telephone survey	38 items	Pop: 93 low-income women in urban Canada[30] Test–retest over 1 wk: .84 α = .80–.92[30]	Not reported	Not reported	Not reported	Gray-Donald et al., 1997[30]

Table 1. *Continued.*

Indicator	Topics	Mode of Data Collection	Length (Items or Min)	Measurement Properties and Study Population: Reliability (Cronbach's alpha; Test–Retest)	Measurement Properties and Study Population: Validity	Measurement Properties and Study Population: Sensitivity to Change	Comparative Data	References
Measures of physical activity/balancing intake								
BRFSS (CDC)	Physical activity	Telephone survey Small group Large group	12 items	49 whites, 43 African Americans, 53 Hispanics in low-income central city neighborhood[12] Test–retest after 10–21 d, kappa: Total: .65; Whites: .57; African Americans: .77; Hispanics: .62[12]	Not reported	Not reported	Annual data for adults by state	CDC[31]; Stein et al., 1995[32];
Physical Activity Questionnaire	Physical activity	In person	20 min (40 items)	Pop: 69 Pima Indian adults[33] Test–retest after 1 wk[33]: α = .76–.96	Pop: 17 Pima Indian adults Correlated with activity monitor: .62[33]	Not reported	Not reported	Kriska et al., 1990[33]
Physical Activity History (developed for CARDIA Study)	Physical activity	Telephone survey In person	13 items (5–10 min)	Pop: 5115 African Americans (54%) and white young adults[34] Test–retest correlation: .77–.84[34]	Correlation with treadmill time[34]: Male: .21 Female: .36	Not reported	Not reported	Lewis et al., 1993[34]; Jacobs et al., 1989[35]
BRFSS (CDC)	Weight management	Telephone survey Small group Large group	6 items	State samples of adults in households with telephone[31] Not reported	Not reported	Not reported	Annual data for adults by state	CDC[31]
Youth Risk Behavior Survey	Weight management	In person Small group Large group	4 items	Pop: grade 7–12 students (15% < $15,000)[37] Test–retest after 14 d: .79[37] Not reported	Not reported	Not reported	Annual data for youth by state	NCHS, 1994[36]; Brener et al., 1995[37]

BRFSS = Behavioral Risk Factor Surveillance System; CDC = National Center for Chronic Disease Prevention and Health Promotion; FFQ = food frequency questionnaire; NCI = National Cancer Institute; CSFII = Continuing Survey of Food Intakes by Individuals; NCHS = National Center for Health Statistics; CARDIA = Coronary Artery Risk Development in Young Adults.

people eat, a single day's 24-hour recall is not a particularly sensitive measure for assessing individual or small-group dietary change. For smaller sample sizes, multiple days of 24-hour dietary recall are needed. This can be expensive and difficult to collect in community settings. Thus, participants are often asked to recall what they ate on the previous day only. Because of considerable dietary variation from day to day, the recalled day should be as representative as possible. Unfortunately, such a day may not exist. Studies with adolescents found that every day of the week should be recalled to acquire accurate data.[11] Studies with women showed that energy consumption is greater on the weekend than during the week.[38] To account for daily variability, a study based on a single 24-hour dietary recall requires a larger sample size than a study that gathers data on multiple days.

Dietary recalls typically result in under-reporting, and there is some evidence that under-reporting is more common among overweight individuals.[39] This may be a special concern for those working with low-income audiences, where overweight is more prevalent than in other subgroups of the U.S. population.[40] Researchers have also found that a 24-hour recall of a single meal by elderly participants underestimates calories actually consumed ($p < .05$).[41]

Other limitations of recall methods include the fact that many dietary assessment programs do not readily classify foods (or mixtures) into food groups, and, in some cases, the number of servings from the different food groups must be estimated by the participant or the nutritionist. This can be especially difficult when working with diverse cultures, cuisines, and literacy levels. Fortunately, some data analysis programs do exist to facilitate the process. For example, the EFNEP Evaluating/Reporting System (ERS) calculates food group consumption and was designed for use with low-income youth and families with young children. It has also been modified to enhance its usefulness for other nutrition education programs.[10] The Healthy Eating Index (HEI) assesses total dietary quality and variety and has been calculated for low-income audiences using Continuing Survey of Food Intakes by Individuals (CSFII) data, although the HEI has not yet been tested for usefulness in program evaluation.[42] Commercial software packages that classify foods into food groups are also available.[43–45]

Food frequency questionnaires. FFQs are another recall method used to evaluate dietary change.[46] Compared with other recall methods, FFQs are relatively quick and inexpensive to administer. Because the early, more comprehensive FFQs were somewhat lengthy, briefer forms have been developed to save time and money without sacrificing validity and reliability.[46–50]

Participants responding to an FFQ report usual consumption over an extended period of time that is specified by the instrument (1 month or more). FFQs address the concept of daily variability in food consumption better than 24-hour recalls, but sufficient time must be allowed for dietary changes to occur before post-test FFQs are used to measure differences. Shorter-term community programs may therefore need a different type of dietary assessment.

Unlike food recalls, FFQs tend to overestimate consumption.[3] Since the number of foods in an FFQ has been shown to correlate positively with the level of overestimation, one might expect a shortened version to be more highly correlated with actual food consumption.[51] However, abridged forms of FFQs may not yield the level of detail needed to determine daily variation in nutrient and consumption patterns (e.g., they may not measure intake of dietary fat or cholesterol, new food products, infrequently consumed fruits and vegetables, or ethnic or regional foods).[52,53] FFQs must use an appropriate or meaningful inventory of the audience's commonly used foods to obtain valid and reliable data.[23] This may be of primary concern when the goal is to measure nutrients such as calcium, which is being added to more foods every day. Also, care must be taken to ensure that food names are consistently interpreted across diverse audiences. For example, in one study, some participants interpreted "tortillas" to mean fried tortilla chips, whereas other participants interpreted "tortillas" to mean uncooked flour or corn tortillas.[54] Kristal et al. suggested that special protocols that include participant training may be needed when using self-administered FFQs in minority or poorly educated audiences.[55]

Like the 24-hour recall method, limitations associated with FFQs also include participant difficulty in determining serving sizes and in assigning combination foods to a single category.[56] In low-income households, measuring cups may not be available for estimating serving sizes, but this problem can be alleviated by providing participants with two-dimensional food depictions or food models to represent amounts.[6,7,15,57] For telephone surveys, two-dimensional models can be mailed to participants prior to the call.

Selecting and administering dietary assessment tools. The evaluation instrument selected depends on the purpose for reporting the measured outcomes, the degree of accuracy and type of data needed to fulfill that purpose, the skill of the staff, and the size, ability, and cooperation of the study population. For the low-income audiences, measurement tools should be easy to comprehend, quick to administer, sensitive to change, and appropriate to audience diversity. It is important to recognize the limitations of traditional methods used to measure dietary change in low-income audiences and to make adjustments when possible. Respondents may have limited reading, writing, and comprehension skills. They may be reluctant to report what and how much they eat, especially if they consider some foods to be of low status or if they have concerns that professionals might be judging their ability to care adequately for their children through the foods they provide. Fear that the children may be removed from the home might cause them to withhold or fictionalize responses.

Dietary assessment methods and instruments may achieve varying levels of validity and reliability among diverse populations. Kristal et al. found the FFQ less valid with African Americans than Caucasians ($p < .001$) and higher in validity among women with fewer than 15 years of education than those with 16 or more years of education ($p < .05$).[55] For ethnic or regional audiences, FFQs may need to be customized to include foods that are major contributors of nutrients in the ethnic or regional diet.[24,58,59] There is also concern that English-speaking participants may respond to FFQs (written in English) differently than Spanish-speaking participants respond to FFQs (written in Spanish) since significant differences in food choices have been shown between Latinos and others.[20]

Consumption from Food Guide Pyramid groups. The following sections discuss measurement instruments used with low-income audiences to assess consumption of foods from each group of the FGP. Additional details regarding each instrument are presented in Table 1. Consumption of a specific number of servings from each food group is typically used as a primary indicator of diet quality. Consumption of a variety of foods within each food group is also recommended. It is likely that variety within groups is not measured as well with FFQs as 24-hour recalls since all individual foods cannot be listed on FFQs. Finally, behaviors that have been shown to predict food group consumption can be used as indicators of dietary quality.

Fruits and vegetables. Assessment of fruit and vegetable intake is considered a single construct for the following reasons: (1) many educational initiatives group them (e.g., the 5 A Day campaign[17]), (2) the nutrient profiles of the two groups are generally similar (i.e., relatively low in calories and fat and high in vitamins and minerals), and (3) most evaluation instruments identified in the literature grouped them.[17] A combined intake of five or more servings of fruits and vegetables per day is recommended. For example, the NCI 5 A Day Baseline Survey assessed combined fruit and vegetable consumption via an FFQ among a nationally representative group of U.S. adults.[60,61] Subsequently, NCI developed a seven-item core fruit and vegetable FFQ for use with adult populations.[15–18,60,61] Adapted from a Block FFQ, the seven items use broad inclusive categories, and the results correlate well with those from longer FFQs.[13,60,62–65] This same brief FFQ has also been used in the Special Supplemental Nutrition Program for Women, Infants and Children and has been validated in a number of U.S. populations, including low-income populations.[13,66–68]

Other FFQs used with low-income audiences include the Behavioral Risk Factor Surveillance System's (BRFSS) six-item fruit and vegetable module, which has been validated among low-income populations.[14,31] This module is similar to but not as encompassing as the NCI seven-item FFQ. The Block FFQ, designed to measure fruit, vegetable, fat, and fiber intake separately, has been validated with a variety of adult audiences, including low-income African Americans.[24] Other FFQs that have not been tested for validity and reproducibility with low-income audiences include two that measure fruits, fruit juices, and vegetables as three separate groups.[69,70]

Bread, cereal, rice, and pasta. A number of questionnaires measure high-fiber cereal and/or bread consumption[28,64,69–71]; however, only one was validated with a low-income audience.[24] For consumption of whole grains among low-income Hispanics, it is useful to target whole-grain breads, corn tortillas, and whole-grain/high-fiber cereals. For instance, 64% of Hispanic adults in California (compared with 41% of Caucasian and 51% of African-American adults) consumed whole-grain/bread or corn tortillas on the day preceding the survey, with respondents in lower-income categories consuming slightly more than those in higher-income households.[72]

Milk, yogurt, and cheese. Our literature search found no instruments that specifically assess dairy consumption with low-income audiences, but many FFQs include dairy products,[23,31,70,73,74] with some having been used with low-income audiences.[31,73] Kristal et al. tested a Food Behavior Checklist in the Women's Health Trial that included questions about milk consumption. General agreement between the checklist and the 24-hour recall was 92% when used in the general population of females; however, overall, the FFQ did not perform as well with African Americans and low-income audiences.[75]

Meat, poultry, fish, dry beans, eggs, and nuts. A literature search found no survey instruments designed to specifically assess protein consumption, although assessment of protein intake is possible via a number of standard FFQs and diet recalls,[23,31,69] with one being validated with low-income audiences.[31] Note that for evaluations of protein consumption in low-income audiences, dry beans should be included in the analysis since they are frequently consumed by some ethnic groups within the low-income audience. The FGP classifies dry beans with the meat group but also approves counting them as vegetables.

Fats, oils, and sweets. Potential indicator foods that may be responsible for a large proportion of total and saturated fat consumption might include whole milk, deep-fat fried foods, fried snack foods, pastries, rich desserts, regular ground beef, and processed meats.[76] The full Block FFQ includes most of these.[23] Briefer FFQs based on the leading food sources of fat identified in the Second National Health and Nutrition Examination Survey (NHANES II) are also available[76] but have not been validated for use with low-income audiences.[28] From 1990 through 1996, the BRFSS included an FFQ, similar to the Block fat screening questions, focused on animal products and validated against more extensive dietary interviews with five demographically diverse population seg-

ments.[31,77] This is inappropriate when the sample size is limited or for populations with diets substantially different from the typical U.S. diets, such as the low-income Hispanic women in this study.

The Quick Check for Fat, a quantitative FFQ covering 28 types of high-fat foods with portion sizes illustrated, is available in Spanish and includes Mexican-American foods; however, it needs to be validated for low-income audiences.[27] It gives somewhat higher estimates of fat calories than other surveys but is able to rank persons by relative fat intake and is stable with repetition.[23] A comprehensive review of dietary fat index questionnaires has been published that includes validity and reliability results for 16 questionnaires, varying in size from 8 to 49 items per assessment. Two of the 16 have been validated with low-income audiences, and one index has been validated with Mexican-American adults.[78]

Dietary practices or behaviors associated with lower-fat diets can also be monitored.[30,79–81] Kristal et al. developed a questionnaire to assess dietary behavior related to fat intake. It explores low-fat diet patterns by asking about the exclusion, replacement, substitution, and modification of fat.[81]

The most recent form of this questionnaire explores diet patterns related to fiber and fat.[71] Neither of these has been validated with low-income audiences. Also, Kristal et al.[82] developed and evaluated a short questionnaire about fat intake that can be used to make rapid assessments, which may be useful when time is limited. Practices such as eating bread without spreads, adding no butter or margarine to vegetables, consuming fruit for dessert, and using low-fat salad dressings are correlated with lower fat consumption among women with a variety of incomes. This questionnaire includes items on the type of milk and cheese eaten, how often fried foods and regular salad dressings are consumed, and how often butter, margarine, oil, or cream is used in preparing meals.[82]

The FGP does not quantify a recommended intake of added sugars, but this can be determined by considering sample diets containing the recommended number of servings from each food group. Calculations suggest that daily intake of added sugars should be limited to about 6 to 18 teaspoons for a 1600- to 2800-calorie diet, respectively.[83] This amounts to 6 to 10% of energy consumed (assuming 1 teaspoon of sugar is 4 g).[84] Current estimates indicate that added sugar consumption averages 16% of energy consumed by Americans aged 2 and older.[85] Specific measures designed to assess added sugars were not found in the literature, but standard measures that include indicator items, such as soft drinks, can yield information on consumption of added sugars.

Measuring behavioral mediators of consumption. Behavior-specific antecedents to behavior change (such as predisposing, enabling, and reinforcing factors) can be measured for promotion of behavior change and program evaluation.[86–88] For example, activities targeting predisposing factors can be designed to raise awareness about diet and health relationships and to give feedback to motivate participants to start changing behavior.

Food preferences, behavior intentions, and sense of self-efficacy about making dietary changes have also been associated with changes in consumption of fats and sugars.[87] However, this review did not find examples in the literature validated with low-income audiences.

Stages of change measures that predict food consumption can be used as an antecedent to the adoption of specific behaviors.[16,29,89–91] Stage of dietary change measures what people think about their eating habits and their interest in change.[88,89] In an ideal application of this model, a nutritionist could assess a client's stage and then deliver a specific sequence of interventions to move that client through successive stages.[89] Studies often include stage of change as a component of dietary assessment.[89,91] Measures must be tailored to the specific foods targeted by the intervention as people may be at different stages of change for different foods.[92]

WEIGHT MANAGEMENT PRACTICES AND PHYSICAL ACTIVITY

It has long been recognized that body weight and PA are important factors in maintaining health and quality of life. Maintenance of a healthy weight requires that both sides of the energy balance equation be addressed (i.e., proper nutrition for appropriate energy intake and PA to burn excess calories and build healthy lean muscle mass).[93] In fact, both body weight, measured as body mass index (BMI), and PA have been highlighted as nutritional concepts in the 2000 Dietary Guidelines for Americans.[2] The Guidelines encourage people to determine their BMI and to manage their weight. These concepts were emphasized in response to the growing prevalence of obesity in the United States, which represents a potential health threat to millions of Americans.[94] Potentially, pre- and post-BMI could be used in program evaluation regarding weight management.

Weight management may be an especially important concept to convey in nutrition education programs for low-income participants since research suggests that individuals from lower-income backgrounds are at higher risk for adult overweight, obesity, and affiliated conditions and chronic diseases.[40,94–97] CSFII 1994–1996 data indicate that, among low-income populations, women who receive food stamps are more likely than non–food stamp participants to be overweight.[40]

To reduce the prevalence of obesity among low-income groups, policy makers have recommended that an incentive system be developed to encourage food stamp recipients to purchase healthful foods and that government agencies do more to make PA attractive and convenient to food stamp clients.[98] Currently, 60% of American adults are not physically

active on a regular basis, and 25% are not active at all, although there is substantial variation by gender, race/ethnicity, age, and income.[87] Therefore, it is no surprise that the prevalence of obesity in the U.S. adult population has increased.[95] Accordingly, the following sections review instruments available to measure practices related to weight management and PA.

Measuring weight management practices. Although it may not always be feasible to collect data regarding body fat (or even weight), it can be useful to gather data on healthy and unhealthy weight management practices or behaviors since they are closely linked to obesity, diet, and PA. Healthy weight management behaviors include increasing the frequency, intensity, and duration of PA; increasing fruit and vegetable intake; and decreasing fat and energy consumption. Unhealthy weight management practices include fasting or skipping of meals, self-induced vomiting, binge eating, and use of diet pills, appetite suppressants, or laxatives. Indicators of weight management variables also include items assessing an individual's perceived weight and dieting status.

Although no measures of weight management practices were found for use specifically with low-income audiences, dieting status and selected weight management practices have been measured in population-based studies with adolescents or adults. These include the Minnesota Adolescent Health Survey, National Longitudinal Study of Adolescent Health, Youth Risk Behavior Survey (YRBS), BRFSS, and National Health Interview Survey.[99–105] In addition, several studies have been conducted on weight loss practices, such as the Pound of Prevention study,[106] and the longitudinal study of eating disorders among adolescent females.[107] There is also a set of knowledge and behavior questions that have been shown to assess the impact of weight control programming across the United States with diverse audiences and diverse programs.[108] The results of several of these and other studies have been published.[109]

In examining the dieting behaviors and socioeconomic status of adolescent females, Story et al. suggested that future research focus on the validity of self-reports of dieting and weight control behaviors in different ethnic subgroups.[110] Others reviewing the literature related to eating behaviors among minority groups stressed the need for focusing on the effects of racism in the development of eating disorders.[111]

Measuring PA. Measuring PA typically involves having subjects complete a checklist of specific PAs (such as occupational, leisure time, or household activities). Respondents recollect the amount of time (and sometimes intensity) spent doing each activity over a specified time frame, such as the previous month.[112] Shorter, more general scales ask the number of occasions a respondent engaged in PA (often separating activity into vigorous, moderate, or mild). PA measures have been used in population-based surveys including the NHANES III, YRBS, BRFSS, and Multiple Risk Factor Intervention Trial.[12,36,113–115]

The reliability of PA scales has been investigated in the BRFSS and YRBS.[12,37,115,116] The questionnaires were developed for specific studies and validated with predominantly white samples, with a few exceptions. Some researchers have described a theoretical model to articulate cognitive theory in relation to survey questions concerning health behavior and to identify potential sources of potential response bias resulting from racial or ethnic cultural experience. They have suggested several ways in which the validity of questions about risk behavior can be improved for culturally diverse groups. These include using interviewers of the same racial or ethnic group or testing questions for potential racial or ethnic bias before using them.[117] Some PA measurement tools have been used or validated with population subgroups and racial and ethnic minorities.[34,37,118–121] These include the Paffenbarger, Physical Activity Questionnaire[119] and CARDIA Physical Activity History.[120,121]

Measuring antecedents to PA. Several measures have been used to assess antecedents to PA. These include social influences or norms, self-efficacy, beliefs about the consequences of being physically active, and intention to be physically active.[122–124] Behavioral antecedents have been applied in the development of theory-based PA interventions. For example, one program was tailored to individual readiness of participants to hear certain messages about PA, depending on their stage of change, and involved the identification and resolution of barriers to PA.[125]

IMPLICATIONS FOR RESEARCH AND PRACTICE

Dietary intake. There is a critical need for studies to fill gaps in our knowledge about how to measure food intake among low-income and minority program participants. These are described below:

- Validation studies of measures of food consumption. It is important to determine if change in consumption of selected foods (called indicator foods) can be used as a proxy for change in total food consumption (e.g., does milk consumption predict total dairy consumption?). It is also important to determine how well general FFQ questions about the number of servings consumed per food group correlate with more detailed measures of consumption (e.g., diet records or recalls).
- Studies to determine whether changes in antecedent variables such as self-efficacy, food preferences, perceived barriers, and knowledge or stage of change can be used to predict change in actual food behavior.
- Studies of regional, age, and racial/ethnic differences that influence interpretation of items on questionnaires that measure food intake.
- Better methods of measuring portion sizes. Portion sizes are not necessarily synonymous with the FGP serving

sizes.[56] Also, few instruments for measuring consumption employ units used in education guidelines.[126]
- Ways to minimize respondent bias. For example, the number of servings reported in pre- and postintervention surveys may change owing to increased knowledge of the food themselves and of serving sizes rather than a change in consumption per se.
- More comprehensive measures of intake of whole grains, high-fiber cereals, and dry beans/legumes.
- Assessment of the validity and reliability of proxy measures for percentage of energy from fat. A complete dietary assessment is needed to assess the percentage of energy from fat, making it difficult to gauge progress against public health goals often stated in terms of fat as a percentage of total calories.
- Evaluation of innovative ways to look at consumption. For example, if a program changed our paradigm from trying to attain an average number of servings of fruits and vegetables per day to attaining a percentage of days on which five or more servings were consumed, then the issues to be faced in the reliability of assessment would be very different.[126]
- Research to determine the optimal data collection approaches to use when evaluating nutrition education interventions with low-income audiences. Potential approaches include face-to-face interviews, self-administered or assisted surveys, touchscreen computer surveys, and other methods.[127]
- Research to determine whether traditional pre- and posttesting should be used with this audience and, if so, under what circumstances?

Weight management and PA. Further research on methodologic issues related to weight control practices and PA among groups is needed, including the following:

- Studies establishing the reliability and validity of instruments measuring self-reported weight loss practices when used with various low-income, sociocultural, and racial/ethnic groups.
- Identifying factors associated with the success of weight management attempts, particularly the role of socioeconomic status. For example, one study indicated that low-income women received less support when they attempted to diet and engaged in worse diet practices than higher-income women.[97]
- Additional explorations regarding the role of ethnicity and social status in perceptions of body satisfaction and weight management practices.
- Reliability and validity of PA measures. Low-income, elderly, and minority populations have been under-represented in previous studies of the reliability and validity of PA measures.
- Research on the applicability of PA measures to diverse ethnic/socioeconomic groups.
- Research identifying determinants of PA including behavioral antecedents and stage of change.

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